REMR Technical Note OM-MS-1.1
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REMR Management Systems for Civil Works Structures

Purpose

This technical note introduces the REMR Management Systems.

Background

The Corps of Engineers oversees a large number of civil works facilities, many of which are now or will soon be reaching their design life. A large amount of funds is needed to maintain and repair these facilities so that they will serve or function as intended. In addition, their service lives must be extended as much as possible, since the Corps has limited resources for constructing replacement facilities. These funding limitations require that maintenance and repair (M&R) needs be prioritized and that available funds be spent efficiently. Prioritization of M&R needs can be greatly facilitated by knowing the condition of facilities, as well as the effectiveness of various M&R alternatives.

Overview

REMR Management Systems are designed to be decision support tools for determining when, where, and how to effectively allocate maintenance and rehabilitation dollars for civil works facilities. These systems are being developed to provide:

a. Objective condition assessment procedures.

b. Means for comparing the condition of facilities and tracking change in condition over time.

c. Procedures for life-cycle cost analysis of different maintenance policies and rehabilitation alternatives.

d. Computer software for storing and organizing data, performing calculations, and producing a variety of reports.

The primary objective of the REMR Management Systems is to help managers obtain the best facility condition for a given budget level.

System Components

All REMR Management Systems typically consist of four modules: inventory, condition inspection and assessment, M&R alternatives, and life-cycle cost-analysis modules. Figure 1 shows the relationships of these modules.

a. *Inventory*. The module is designed to store inventory information for structures and associated components whose maintenance is overseen by the Corps' Districts or Divisions; this information includes data elements like structure/component type, construction date, location, and physical dimensions.

b. *Condition inspection and assessment*. The condition of a facility is assessed through uniform evaluation procedures. For each facility or component (e.g., a miter lock gate), experts are consulted to develop inspection procedures and an algorithm that together produce a condition index (CI) (see REMR Technical Note OM-CI-1.2). The CI is adopted to express the condition of a facility numerically. The CI algorithm is designed to produce CI's that reflect those conditions shown in Figure 2. Great care is taken in the development of the algorithms and inspection procedures to ensure that the results are consistent and repeatable. This uniformity allows a ranking of condition in similar structures on a District-, a Division-, or a Corps-wide basis.
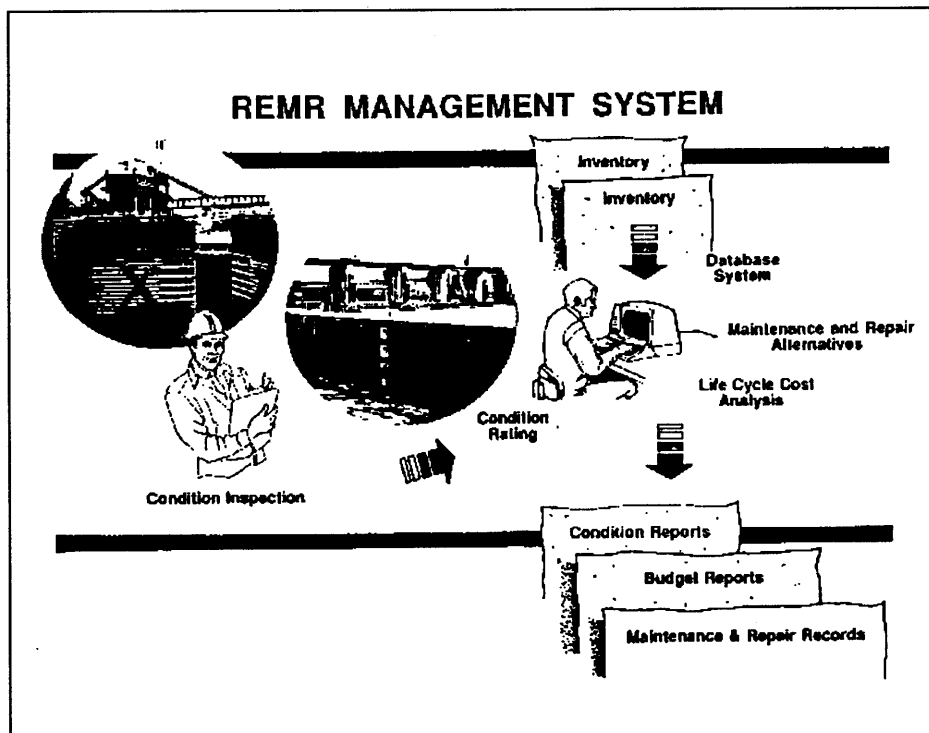

Figure 1. REMR Management System

alternatives for any given component for which a CI algorithm has been developed. These alternatives are called upon in the life-cycle cost-analysis portion of the program. Users can add new alternatives as they become known. The REMR Management Systems allow the entry and storage of data pertaining to actual M&R performed on a structure. Such M&R history has not been available in a centralized location.

d. *Life-cycle cost analyses.* Various M&R plans with assorted economic consequences can be developed. The scope of these plans is generally at the project level (e.g., a plan for REMR activity to be performed at a single lock and dam). Plans that explore the expenditures needed to produce a desired condition level within a specified time frame are readily at hand.

Existing Systems Within Civil Works

An overall REMR Management System is currently being developed for navigation structures. Component management systems that are complete or near completion address horizontally framed miter lock gates, steel sheet piles,

REMR Condition Index Scale			
Zone	**Condition Index**	**Condition Description**	**Recommended Action**
1	85 to 100	**Excellent**: No noticeable defects. Some aging or wear may be visible.	Immediate action is not required.
	70 to 84	**Good**: Only minor deterioration or defects are evident.	
2	55 to 69	**Fair**: Some deterioration or defects are evident, but function is not significantly affected.	Economic analysis of repair alternatives is recommended to determine appropriate action.
	40 to 54	**Marginal**: Moderate deterioration. Function is still adequate.	
3	25 to 39	**Poor**: Serious deterioration in at least some portions of the structure. Function is inadequate.	Detailed evaluation is required to determine the need for repair, rehabilitation, or reconstruction. Safety evaluation is recommended.
	10 to 24	**Very Poor**: Extensive deterioration. Barely functional.	
	0 to 9	**Failed**: No longer functions. General failure or complete failure of a major structural component.	

Figure 2. REMR CI scale

and concrete lock walls (Greiman, Stecker, and Rens 1995; Geimann and
Stecker 1989; McKay and Kao 1990; Bullock 1989). In the coastal protection
area, a system for rubble-mound breakwaters and jetties is in development
(Plotkin, Davidson, and Pope 1991). A system is also being developed for
timber training dikes (Yu and Kao 1989). Each of these systems has undergone
initial field testing, all with high degrees of success. These systems are
available on diskette, for IBM-AT compatible, Disk Operating System (DOS),
environments.

Future Developments

Immediate attention is focused on completing a system that addresses all
suitable components within a navigation lock and dam. System development
for other coastal protection and inland waterways structures is also underway.

References

Bullock, R.E. (1989). "A Rating System for the Concrete in Navigation Lock
Monoliths," Technical Report REMR-OM-4, U.S. Army Engineer
Waterways Experiment Station, Vicksburg, MS.

Greimann, L. and Stecker, J. (1989). "User's Manual: Inspection and Rating of
Steel Sheet-Pile Structures," Technical Report REMR-OM-3, U.S. Army
Construction Engineering Research Laboratories, Champaign, IL.

Greimann, L., Stecker, J., and Rens, K. (1995). "Maintenance and Repair of
Miter Lock Gates," Technical Report REMR-OM-8, U.S. Army
Construction Engineering Research Laboratories, Champaign, IL.

McKay, D.T., and Kao, A.M. (1990). "LOCKWALL: A Microcomputer-Based
Maintenance and Repair Management System for Concrete Navigation Lock
Monoliths," Technical Report REMR-OM-10, U.S. Army Construction
Engineering Research Laboratories, Champaign, IL.

Plotkin, D.E., Davidson, D.D., and Pope, J. (1991). "REMR Management
Systems - Coastal/Shore Protection Structure; Condition Rating Procedure
for Rubble Breakwaters and Jetties," Technical Report REMR-OM-11, U.S.
Army Construction Engineering Research Laboratory, Champaign, IL.

Yu, H.T., and Kao, A.M. (1989). "Timber Dike Management System,"
Technical Report REMR-OM-5, U.S. Army Construction Engineering
Research Laboratory, Champaign, IL.